



# AEC-NASA TECH BRIEF



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## 4 $\pi$ -Recoil Proportional Counter Used as Neutron Spectrometer

A study has been made, whose purpose was to describe an application of proton-recoil proportional counters to the measurement of neutron spectra. This technique is limited to measurements of neutron spectra in the energy region from about 1 keV to about 1 MeV. Neutrons are generally detected by their interactions with nuclei. These interactions are normally either proton-recoil or positive Q reactions. Both methods are in current use for studies of neutron spectra. In general, positive Q reactions (energy emitting) are better suited to higher energy applications while the proton-recoil proportional counter method performs best at lower energies (below 1 MeV).

The detection of proton-recoil events in proportional counters will usually be made complicated by the presence of gamma-ray induced background noise. Electronic discrimination techniques can be made effective against this background and have been applied to neutron spectroscopy. Discrimination is essential for extending the method to the lowest energies. Pulse-shape discrimination is one of the useful electronic discrimination techniques, and was incorporated into the 4 $\pi$ -recoil counter.

In this study, special emphasis was placed on the problems encountered when using 4 $\pi$ -recoil counters. The study considered problems of calibration, shape discrimination, variation of W, the average energy loss per ion pair, and the effects of differentiation on the intrinsic counter resolution. These problems have also been studied using measurements made on the characteristic 1/E neutron slowing-down spectrum.

Possible solutions to these problems are presented in the study report.

### Notes:

1. The study was reported in *A Study of the 1/E Slowing-Down Neutron Spectrum Using 4 $\pi$ -Recoil Proportional Counters*, by E. F. Bennett, in report number ANL-6897, published by the Argonne National Laboratory, Argonne, Illinois. Recent publications include: (1) *Fast Neutron Spectroscopy by Proton-Recoil Proportional Counting*, Nucl. Sci. Eng. 27, 16 (1967); and (2) *Neutron Spectrum Measurement in a Fast Critical Assembly*, Nucl. Sci. Eng. 27, 28 (1967).
2. Although the use of recoil counters may be known to researchers associated with the field, this report provides reinforcement data concerning the use of this technique.
3. Reference: The report ANL-6897 is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151; price \$3.00 (microfiche \$0.65.)
4. Inquiries concerning this innovation may be directed to:

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Reference: B68-10326

Source: E. F. Bennett  
Reactor Physics Division  
(ARG-10101)

(continued overleaf)

**Patent status:**

Inquiries about obtaining rights for commercial use  
of this innovation may be made to:

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